FEMA 209: 481483

FLOOD INSURANCE STUDY

ORIGINAL

COMPLETE

26

CITY OF MONTGOMERY, TEXAS

MONTGOMERY COUNTY

MAY 17, 1982

Federal Emergency Management Agency

COMMUNITY NUMBER - 481483

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FLOOD INSURANCE STUDY
CITY OF MONTGOMERY, TEXAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Montgomery, Montgomery County, Texas, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the City of Montgomery to the regular program of flood insurance by the Federal Emergency Management Agency (FEMA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the Soil Conservation Service and Stottler Stagg and Associates, Inc., with topographic and hydraulic structure data provided by Aero Services, Inc., for the Federal Emergency Management Agency, under Interagency Agreement No. IAA-H-877. This study was completed in June 1981.

1.3 Coordination

Streams requiring detailed study were identified at a meeting attended by the study contractor, representatives of FEMA, and community officials in August 1976. An additional intermediate coordination meeting was held on May 21, 1981.

On December 18, 1981, the results of the study were reviewed at the final CCO meeting attended by representatives of the study contractor, FEMA, and community officials. The study was acceptable to the community.

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2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the entire incorporated area of the City of Montgomery. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction for the next five years, through 1986.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by FEMA, and the City of Montgomery.

2.2 Community Description

The City of Montgomery is in the northwestern portion of Montgomery County which is in the southeast part of the state of Texas. The community is approximately 45 miles north of Houston, Texas.

2.3 Prinicipal Flood Problems

The only flood problems in existence in the City of Montgomery are flooding from Town Creek, Stewart Creek North and Town Creek Tributary.

2.4 Flood Protection Measures

There are no flood protection measures in existence in the City of Montgomery at this time.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, and 500-year period (recurrence intervals), have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50 year period is about 40 percent (four in 10), and for any 90 year period, the risk increases to about 60 percent (six in 10). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

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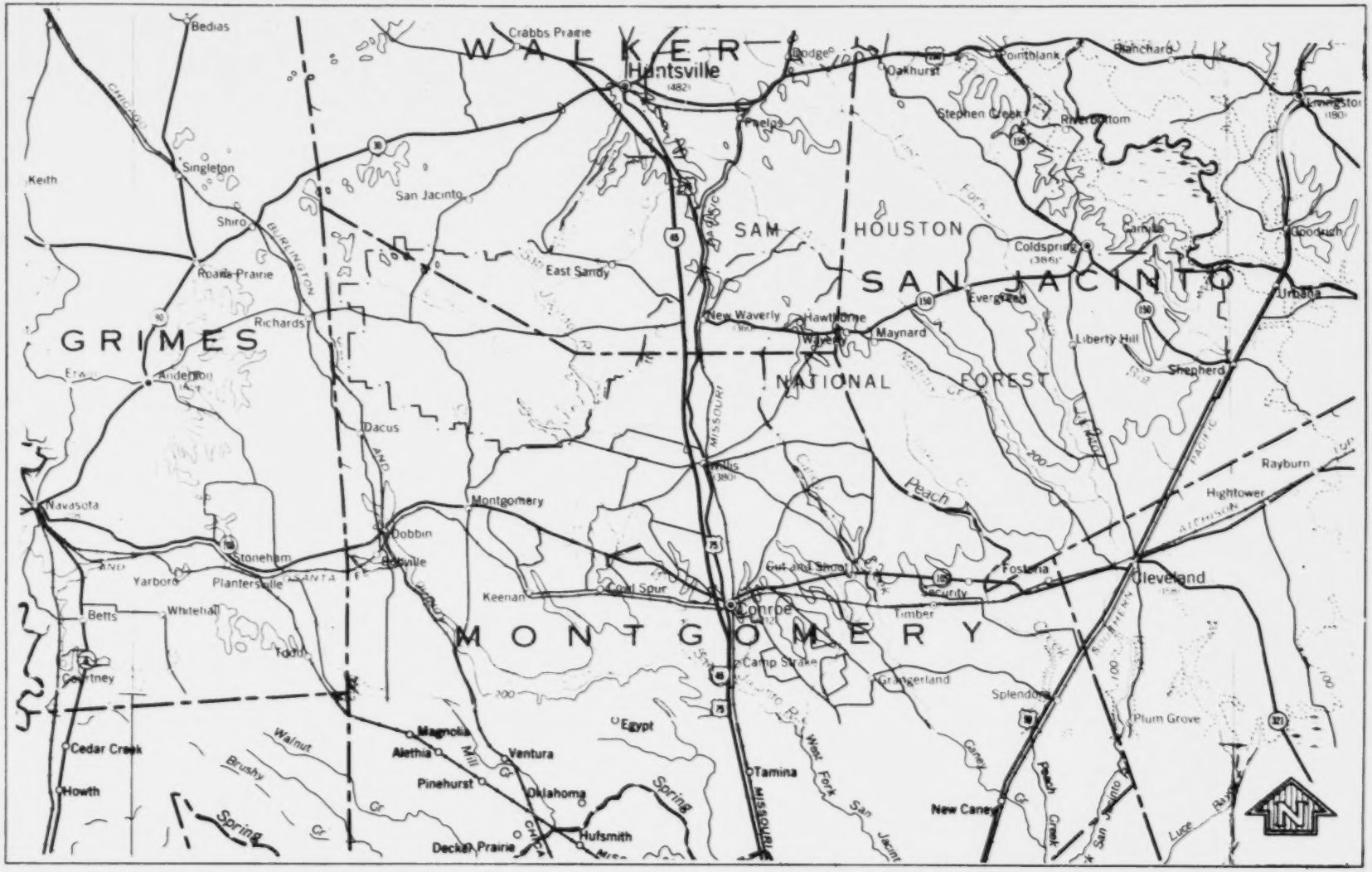

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MONTGOMERY, TX

(MONTGOMERY CO.)

APPROXIMATE SCALE

10 0 10 20 30 MILES

VICINITY MAP

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3.1 Hydrologic Analyses

Peak Discharge frequency analysis was made using SCS TR-20 computer program for floods of selected recurrence intervals for each flooding source studied in detail in the community (Reference 1).

The discharge of Town Creek is attenuated between cross section B and cross section C due to storage effects. These discharges are listed on the Summary of Discharge Table (Table 1).

The peak discharge-drainage area relationships for the selected recurrence intervals are presented in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TOWN CREEK					
At cross section A	5.17	1,759	3,376	4,285	6,864
At cross section B	5.17	1,759	3,376	4,285	6,864
At cross section C	4.75	1,788	3,429	4,352	6,969
STEWART CREEK NORTH					
At cross section A	1.81	823	1,592	2,026	3,255
At cross section B	0.26	168	322	409	654
At cross section C	0.26	168	322	409	654

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in detail in the City of Montgomery were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the flood sources.

Cross sections, as well as dam, bridge, and culvert data used in the backwater analyses of the streams in the study were obtained from field surveys by Aero Services, Inc.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed, selected cross section locations are also shown on the Flood Boundary and Floodway Maps.

Channel roughness factors (Manning's "n") used in the hydraulic computations, were chosen utilizing engineering judgement, aerial photos, USGS topographic maps, and field observations of the streams and flood plain areas (Reference 2). Roughness values for the main channel areas ranged from 0.035 to 0.15 with flood plain roughness values ranging from 0.06 to 0.15.

Water-surface elevations of floods of the selected recurrence intervals were computed using the SCS WSP-2 step-backwater computer program (Reference 3). Flood profiles were drawn showing computed water-suface elevations for floods of the selected recurrence intervals. Staring water-surface elevations for all streams were derived from the estimated 10-, 50-, 100- and 500-year flood elevations at Conroe Lake, calculated by the Soil Conservation Service. In some instances a preliminary hand calculation was necessary to provide a smooth transition from lake elevation to the first cross section flood elevation on the stream in question. All elevations are referenced from Mean Sea Level; elevation reference marks used in this study are shown and described on the Flood Boundary and Floodway Map.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by FEMA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and the 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using a topographic map at a scale of 1" = 2000' with contour intervals of 5 feet. In cases where the 100- and the 500-year flood boundaries are close together, only the 100-year boundary has been shown. Small areas within the flood boundaries may lie above the flood elevations, and therefore, may not be subject to flooding. Owing to limitations of the map scale and/or lack of detailed topographic data, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any

adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of FEMA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction of each side of the flood plain using the SCS Floodway Determination Computer Program (Reference 4). The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2).

As shown on the Flood Boundary and Floodway Maps, the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In case where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the 100-year boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Town Creek								
A	12,403	216[2]	1,481	2.89	240.8	240.8	241.8	1.0
B	12,503	265[3]	1,764	2.43	241.8	241.8	242.8	1.0
C	14,458	468	2,360	1.84	243.1	243.1	244.1	1.0
Stewart Creek North								
A	18,749	57[2]	372	5.45	243.5	243.5	244.5	1.0
B	22,177	33	109	3.77	266.9	266.9	267.4	0.5
C	22,277	143	948	0.43	273.8	273.8	274.8	1.0
Town Creek Tributary								
A	1,938	79[2]	359	3.87	251.3	251.3	252.3	1.0
B	4,734	85[2]	322	2.06	265.5	265.5	266.0	0.5

[1]Feet above mouth

[2]Floodway lies outside corporate limits

[3]Floodway width extends beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MONTGOMERY, TX

(MONTGOMERY CO.)

FLOODWAY DATA

TOWN CREEK-STEWART CREEK NORTH - TOWN CREEK TRIBUTARY

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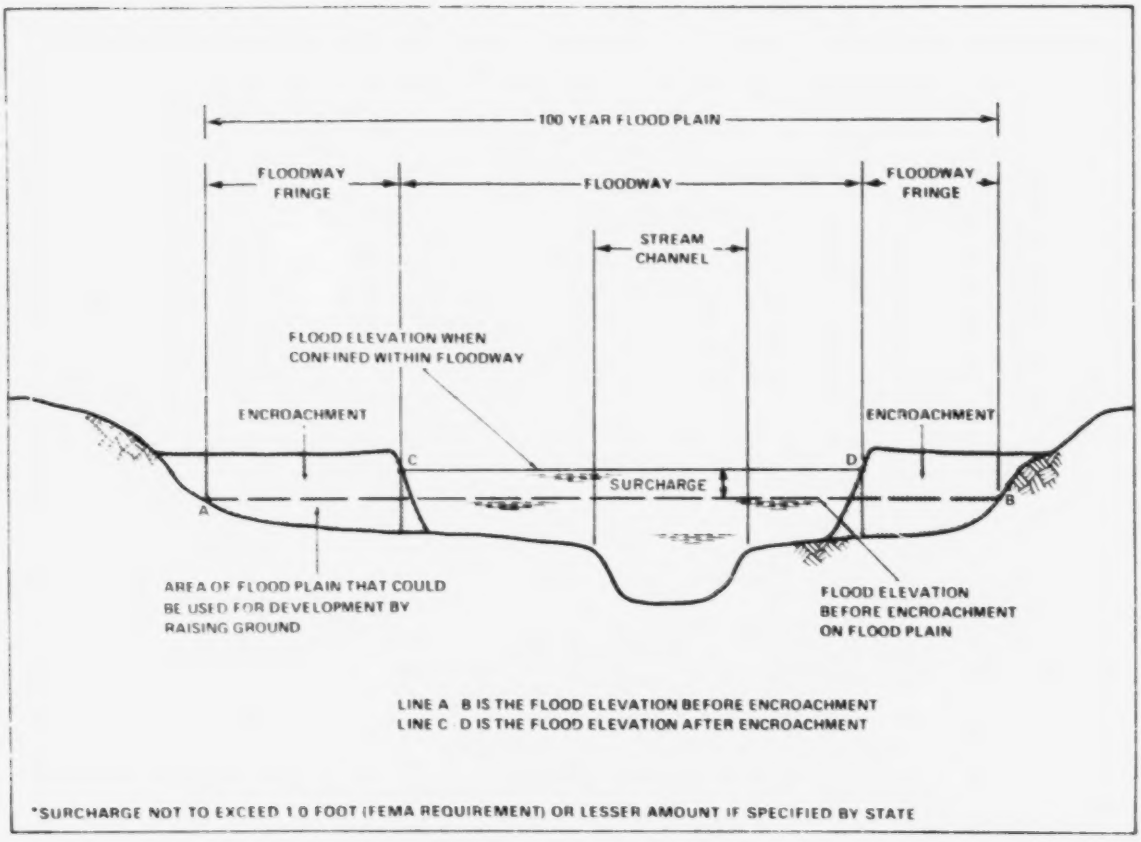
100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FLOODWAY SCHEMATIC Figure 2

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, FEMA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each significant flooding source affecting the City of Montgomery.

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5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in watersurface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet

Numerous reaches throughout the study area met the above criteria. The locations of the reaches are shown on the Flood Profiles.

5.2 Flood Hazard Factors (FHFs)

The Flood Hazard Factor is used to correlate flood information with insurance rate tables. Correlations between property damages from floods and their assigned FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between the water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, the accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the City of Montgomery was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A3, A4, and A7:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHFs.

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Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; or areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevation for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Montgomery is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by FEMA.

6.0 OTHER STUDIES

A study is underway for Montgomery County, Texas but has not yet been published. No discrepencies are expected between this study and the Montgomery County study.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Federal Center, Denton, Texas 76201.

8.0 BIBLIOGRAPHY AND REFERENCES

1. U.S. Department of Agriculture, Soil Conservation Service, Computer Program for Project Formulation, Technical Release No. 20, May 1965.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3]
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Town Creek							
Reach 1	0001	-1.5	-0.4	+1.1	015	A3	Varies
Reach 2	0001	-2.0	-0.7	+1.1	020	A4	Varies
Reach 3	0001	-1.3	-0.4	+0.8	015	A3	Varies
Stewart Creek North							
Reach 1	0001	-3.3	-0.7	+1.6	035	A7	Varies
Reach 2	0001	-2.1	-0.4	+1.2	020	A4	Varies

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT-SEE MAP

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MONTGOMERY, TX

(MONTGOMERY CO.)

FLOOD INSURANCE ZONE DATA

TOWN CREEK-STEWART CREEK NORTH

BEST DOCUMENT AVAILABLE

2. Chow, Ven T., Open Channel Hydraulics, McGraw-Hill Book Company, 1959.

3. U.S. Department of Agriculture, Soil Conservation Service, WSP2 Computer Program, Technical Release No. 61 May 1976.

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U.S. Department of Transportation, Federal Highway Administration, Hydraulics of Bridge Waterways, March 1978.

Texas Highway Department, Bridge Division, Hydraulic Manual, September 1970.

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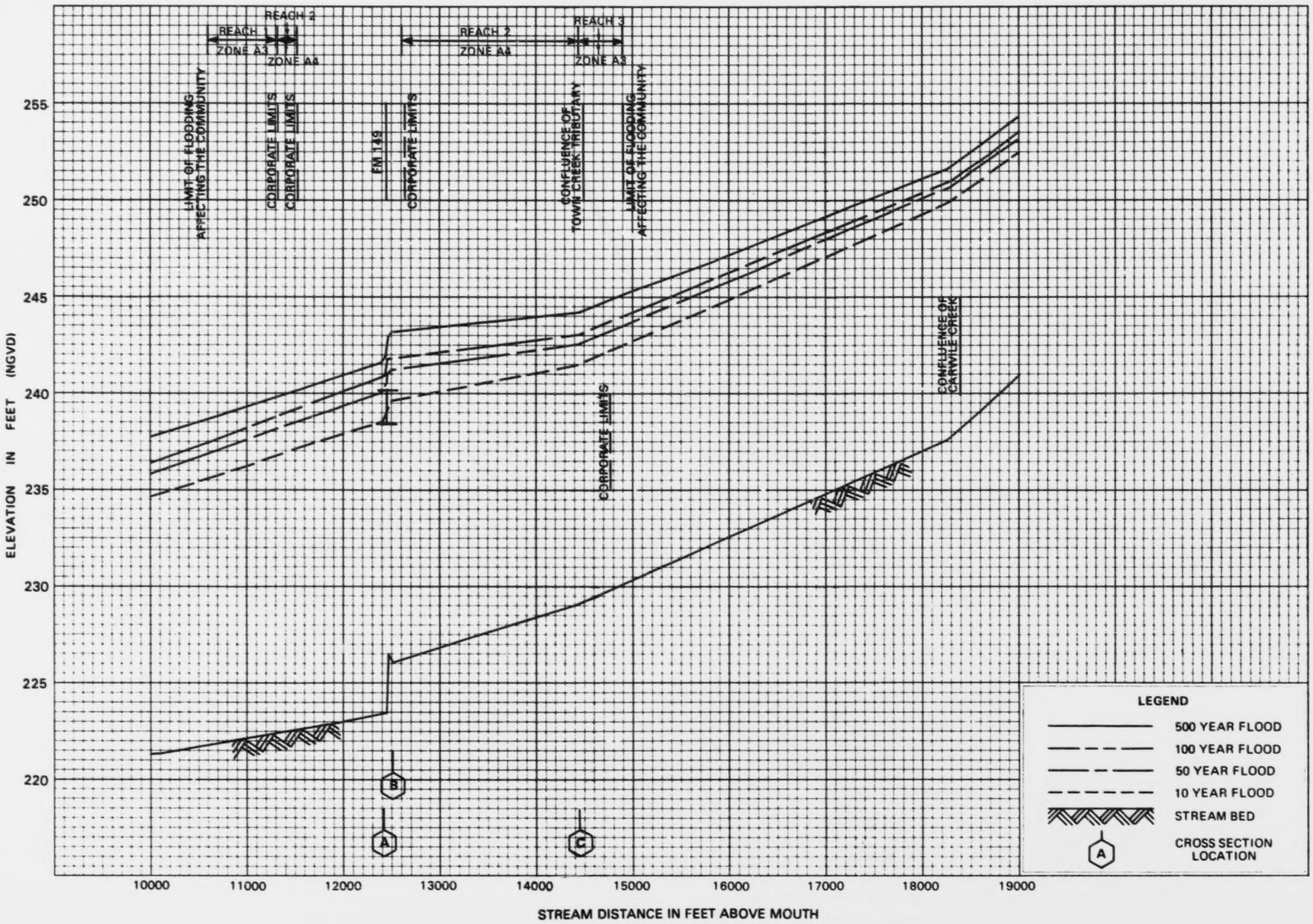

FLOOD PROFILES

TOWN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MONTGOMERY, TX
(MONTGOMERY CO.)

01P

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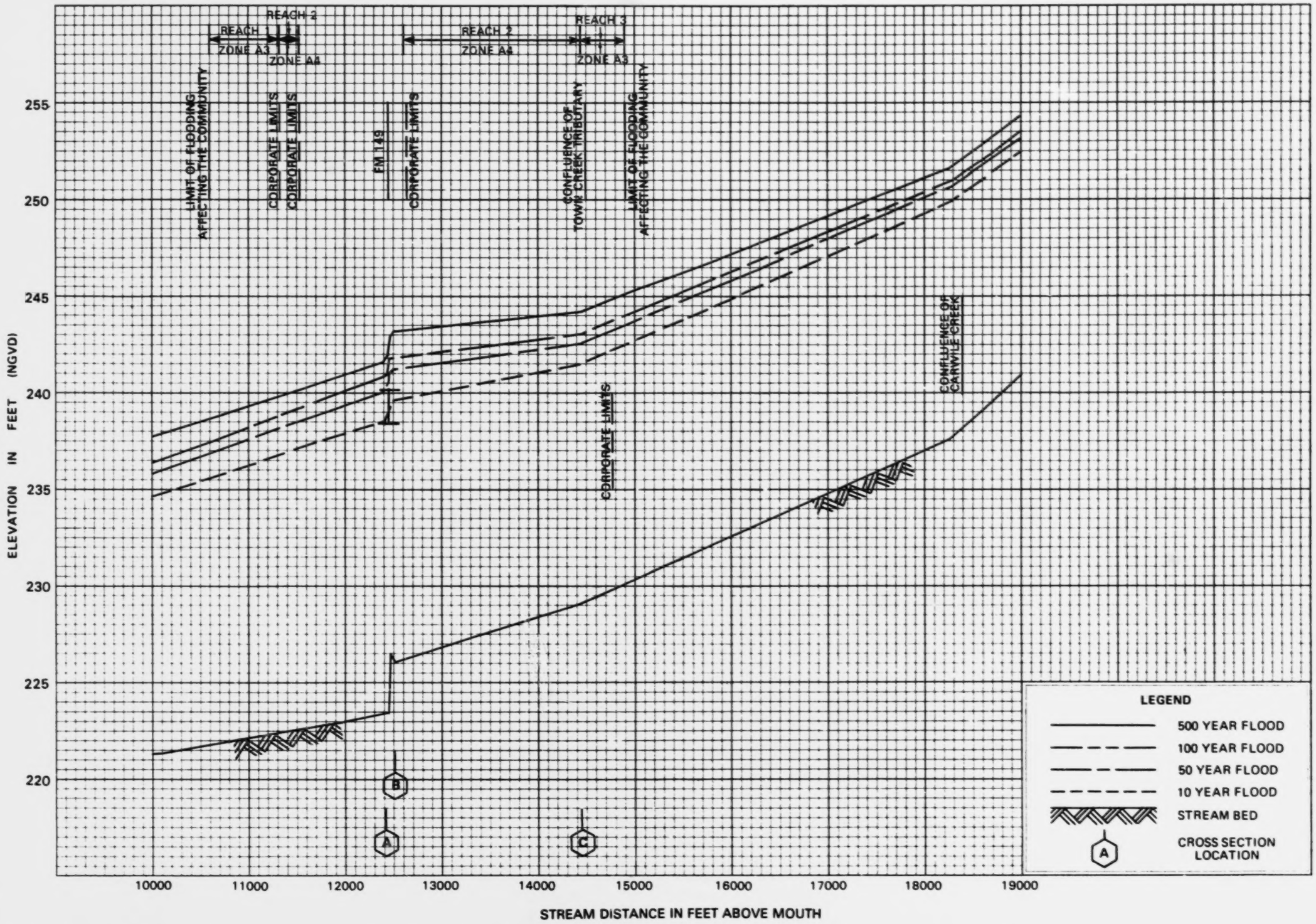

FLOOD PROFILES

TOWN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MONTGOMERY, TX
(MONTGOMERY CO.)

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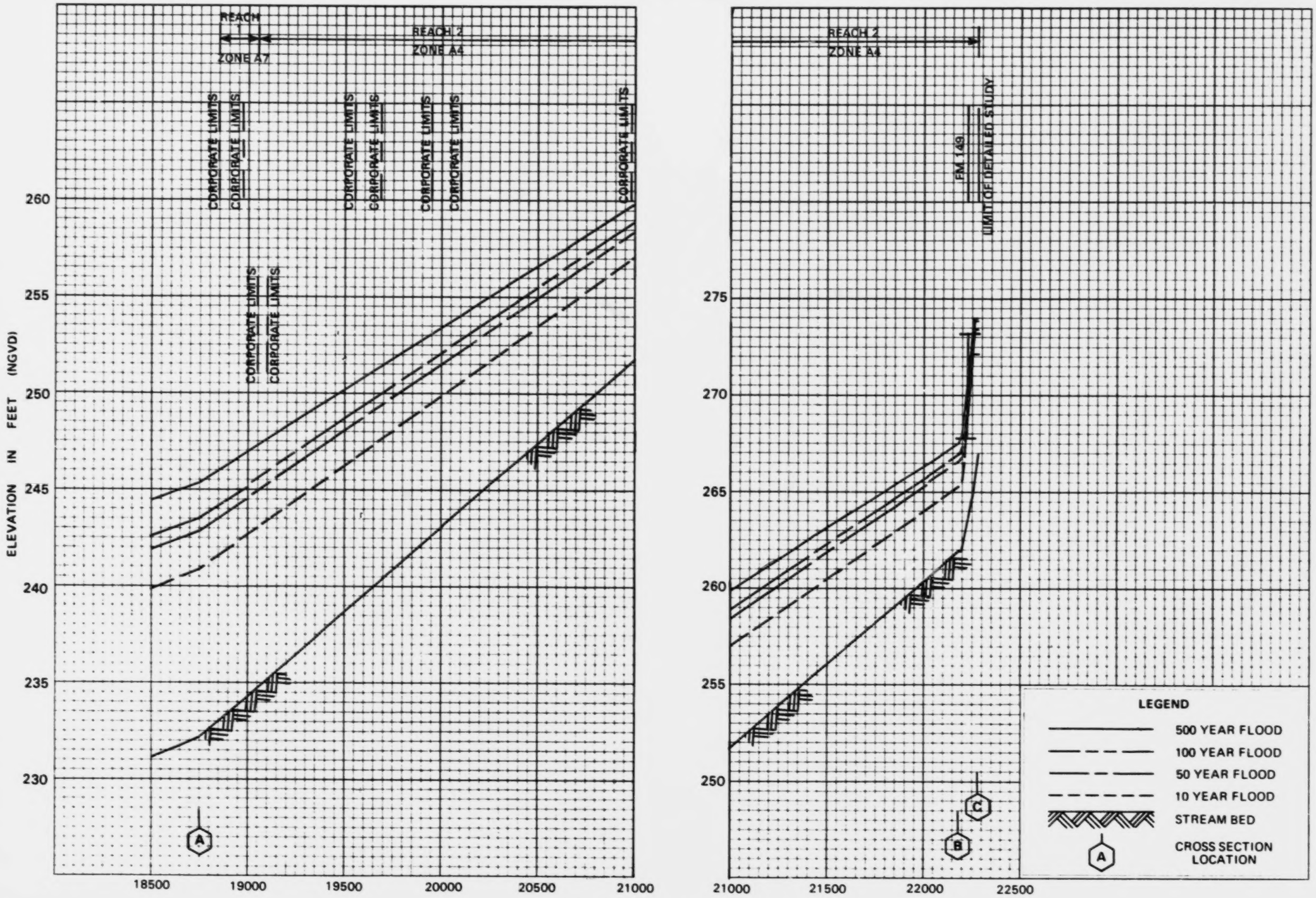

FLOOD PROFILES

STEWART CREEK NORTH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MONTGOMERY, TX
(MONTGOMERY CO.)

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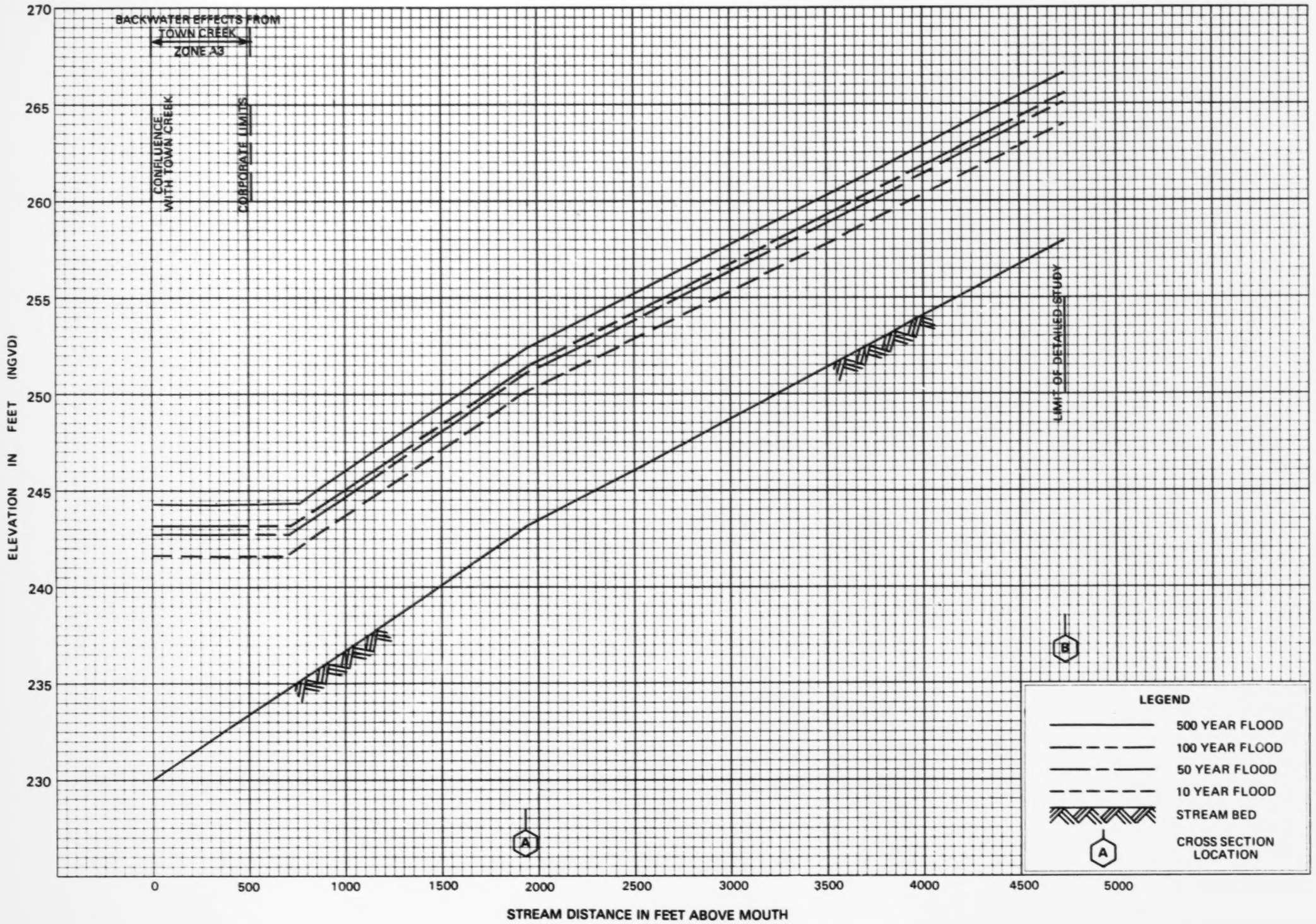

FLOOD PROFILES

TOWN CREEK TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MONTGOMERY, TX
(MONTGOMERY CO.)

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